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ABSTRACT

This guide for a model industrial arts curriculum for state and local planning has been designed for public school administrators and teachers who wish to establish an industrial arts curriculum in their school or would like to expand an existing one. Covering levels K-12, the guide first suggests a program by operational levels. It then outlines programs for elementary, junior high, and senior high school industrial education. Concepts to be taught and learning activities are suggested for each level. The elementary level is more general, while the junior and senior high levels focus on specific subjects of the industrial arts curriculum. Topics covered in the junior high curriculum include industrial and technological literacy, communications, construction, manufacturing, energy/power, and transportation. Senior high curriculum concentrates on design/drafting, graphic arts, construction, wood technology, industrial crafts, electrical/electronic technology, plastics technology, metal technology, and power technology. Goals and sample outcomes are provided for each area of instruction. Suggestions for teacher education also are provided. Appendixes to the guide review instructional approaches, suggest evaluation standards for industrial education, and outline the services of the South Dakota Association of the American Industrial Arts Student Association. A list of resources is included in the guide. (KC)

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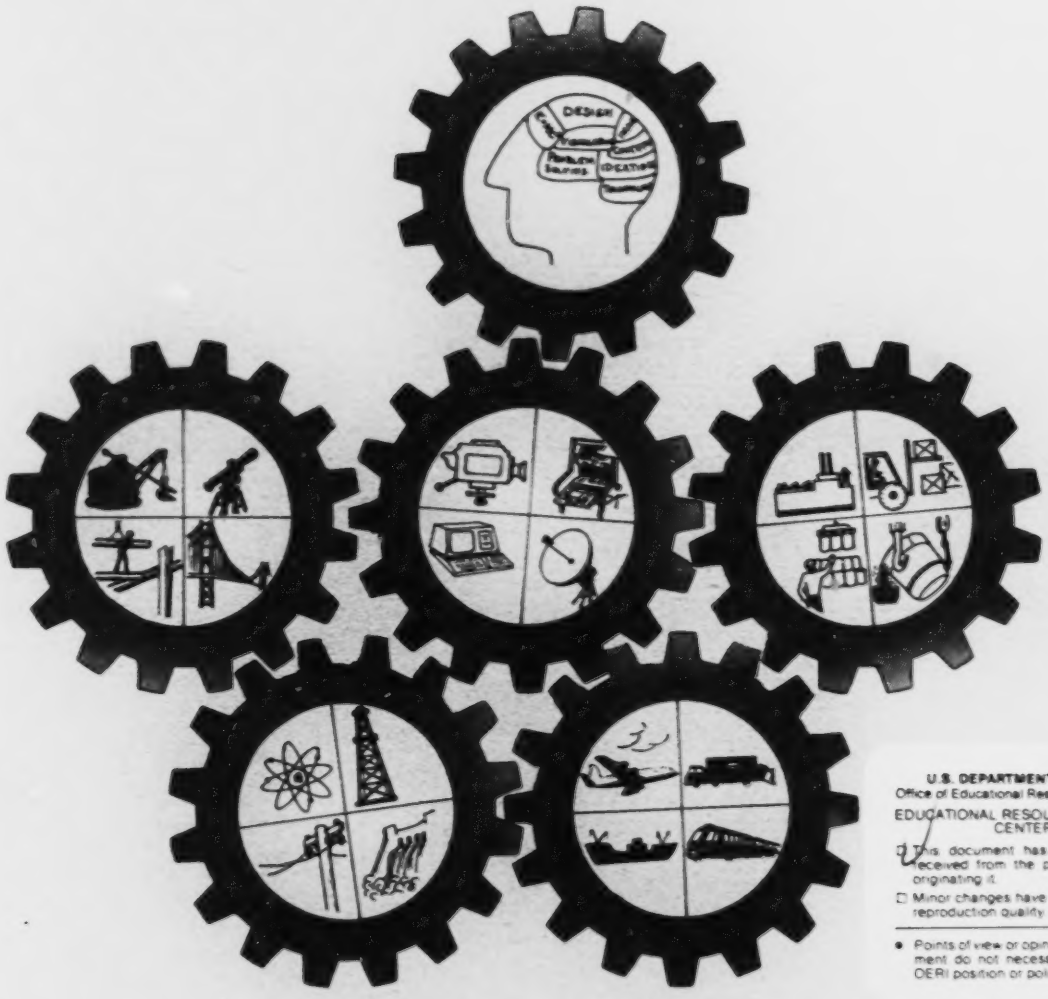

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Industrial Education

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Guide For Elementary And Secondary Program Development And Improvement In Industrial Arts, K-12

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FOREWORD

The educational experiences proposed in this guide offer rich opportunities for students to become acquainted with their industrial and technological culture. The format and content is uniquely helpful in providing information to managers of the learning process as they search for ways to assure that the career development goals and industrial-technological goals are incorporated in the educational program.

Dr. James Hansen
Superintendent of Elementary
and Secondary Education

ACKNOWLEDGEMENTS

Recognition and grateful appreciation are extended to each contributor and consultant. Special tributes are paid to Dr. Terry Richardson, who ably guided and managed the production of this guide.

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PREFACE

Presented here is a guide or model industrial arts curriculum for state and local planning. This curriculum guide has been designed for public school administrators and teachers who wish to establish an industrial arts curriculum in their school or would like to expand an existing one. The curriculum provides many opportunities for course development at the elementary through senior high levels. It will also help teachers and administrators determine which elements of an industrial arts curriculum are of greatest value to students.

In addition to exploring the aims of an industrial arts curriculum, this guide will also help teachers determine which courses constitute a viable curriculum and what scope and sequence these courses should take.

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INTRODUCTION

During the series of events which expanded vocational education it became apparent that industrial arts education could make a significant contribution to occupational awareness, exploration, and core element skills because many of its long-held objectives now paralleled those of the legislated comprehensive vocational educational program.

In order to fulfill the intent of federal legislation, a sequence of courses, explained in this guide, has been approved and is recommended to school districts. The guide is designed as a staff development aid to teachers so that they may more effectively organize and teach the subject content.

Industrial Arts Education is a branch of vocational education for those courses which fulfilled the objectives of the federal Vocational Education Act and South Dakota Comprehensive Industrial Arts Education Program structure.

Industrial Arts Education programs means those education programs which (1) pertain to the body of related subject matter, or related courses, organized for the development of understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology including learning experiences involving activities such as experimenting, designing, constructing, evaluating, and using tools, machines, materials, and processes which provide opportunities for creativity and problem solving; (2) assist individuals in making informed and meaningful occupational and educational choices; and (3) develop competencies needed for success and advancement in a higher level secondary or post-secondary program.

Freedom and flexibility to innovate and to develop unique approaches and methodology for a particular teaching situation have been delegated to the practicing industrial arts education teacher and the administration of the local school district (see Appendix A).

While this guide is different from previous versions, it is consistent with current philosophical trends in industrial arts education (see Appendix B). Throughout the guide emphasis has been placed on recent developments and ideas in order to make it as up-to-date as possible. Contents of this document suggest an organized program structured to provide teaching concepts that will more realistically lead to fuller comprehension of industry and technology. This approach should better meet the challenges of our time and the needs of our youth.

The advent of new and rapidly advancing industrial processes has made some traditional subject areas of industrial arts education obsolete in relation to contemporary industrial scenes throughout the country. Therefore, public school programs should incorporate content which reflects industry and technolgoy.

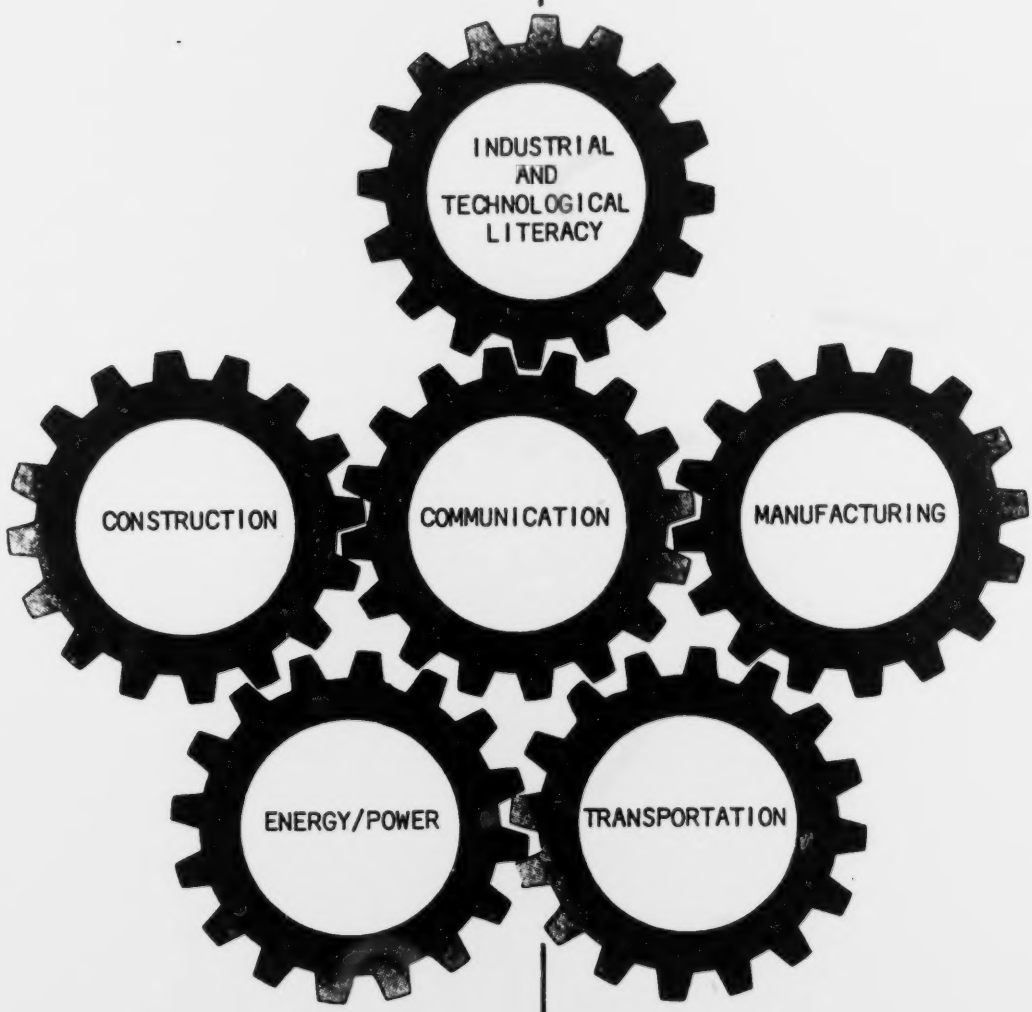
Traditional industrial arts education courses emphasize drawing, woodworking, metalworking, and a few other skill-oriented areas, but do not represent the entire scope of contemporary industry. However, technology has advanced tremendously during the last three decades. No longer can society

afford to permit a student to think of industry as being represented solely by drawing, woodworking, metal-working or other traditional craft-oriented areas. Industrial arts education always has claimed to provide youth with insights into industry.

Industrial arts education has a mission to arouse the interest of the student with ideas dealing with industry and technology. A natural setting for providing for these individual differences is found in the industrial laboratory. Teaching procedures which encourage discovery and generalization have been found to be superior to drill for most students. Sheer repetition and drill may destroy desire for understanding as well as curiosity, imagination, and creativity. Problems are solved in the industrial laboratory by discovery of the relationship between elements of the situation which will satisfy requirements of a problem. In so doing, the student is not only developing a mastery of the fundamental ideas of industry, but also is developing a desirable attitude about learning. As the public schools continue to place more emphasis on decision-making objectives, valid activities are needed to support these objectives. An activity becomes a learning experience only when it draws the response of a student. The more positive the feeling of the student toward the activity, the more permanent the learning. Too often students in classes are told to watch and listen without having an opportunity to act upon what they have observed. Industrial arts education, as it has in the past, should continue to be known for its role of making the student and active participant rather than a passive spectator. The element of change should be the activities, experiences, and methodology which reflect the intent of the philosophy and objectives.

INDUSTRIAL ARTS EDUCATION

IS THE STUDY OF



TO ACQUAINT STUDENTS WITH

THEIR POTENTIAL	AMERICAN INDUSTRY	CAREERS	INDUSTRIAL TECHNOLOGY	HUMAN & NATURAL RESOURCES

THEREBY ENABLING THEM TO

INTERACT WITH THEIR CULTURAL AND TECHNOLOGICAL ENVIRONMENT

SCHEMATIC INTERRELATIONSHIP AND SEQUENCE OF PROGRAMS

AWARENESS	ORIENTATION	EXPLORATION	PREPARATION	SPECIALIZATION
Insights ⟷	Conceptualization	⟷	Pre-technical	⟷ Post Secondary
ACTIVITIES INTEGRATED WITHIN CURRICULUM	INDUSTRIAL LITERACY AND TECHNOLOGICAL LITERACY	COMMUNICATION CONSTRUCTION MANUFACTURING ENERGY/POWER TRANSPORTATION	DESIGN-DRAFTING GRAPHIC ARTS CONSTRUCTION WOOD TECHNOLOGY INDUSTRIAL CRAFTS ELECTRICITY/ ELECTRONICS PLASTICS TECHNOLOGY METALS TECHNOLOGY POWER TECHNOLOGY	ENGINEERING PROGRAMS INDUSTRIAL TECHNOLOGY PROGRAMS TECHNICAL INSTITUTES VOCATIONAL-TECHNICAL SCHOOLS APPRENTICESHIP ON-THE-JOB TRAINING TEACHER EDUCATION
Activities ⟷	Laboratory Clusters	⟷	Unit or General Laboratory	⟷ Specialized Unit Laboratory
K - 6	7 - 8	9 - 10	11 - 12	13 - 17

RECOMMENDED PROGRAM BY OPERATIONAL LEVELS

The suggested direction for industrial education is graphically summarized on the following two pages. Industrial clusters are then highlighted by outlining the major components that serve as a framework for the clusters and from which more detailed courses of study can be developed. As stated earlier, the material contained herein carefully avoids being prescriptive and only then serves as a guide by providing a structure. No attempt has been made to develop detailed outlines or courses of study; this should be done by the practicing industrial educator.

ELEMENTARY SCHOOL PLAN
INDUSTRIAL ARTS EDUCATION IN GRADES K-6

Description:

Elementary school industrial arts activities are designed to further the attainment of educational goals derived from the elementary school curriculum as a whole. These activities provide opportunities for students to develop concepts and skills through concrete experiences, such as the manipulation of tools and materials. Elementary Industrial Arts usually incorporates the classroom teacher in a regular classroom setting to broaden and reinforce the elementary subjects. The program teaches students about technology, develops personal psychomotor skills, and refines attitudes about technology's influence on society. Through the program, students will be enabled to do the following:

1. Work with tools, materials and technical processes;
2. Develop an awareness of the role of industry in a technological society;
3. Develop awareness of industrial-related careers and their role in society;
4. Develop attitudes of cooperation and self-reliance through problem-solving situations;
5. Integrate and enrich concepts in the language arts, sciences, social studies, mathematics and other areas in the elementary school curriculum;
6. Appreciate craftsmanship in others and the dignity of all useful work.

Goal Awareness:

The goal of the elementary level industrial arts program is to provide learning reinforcement that contributes to students' personal development and industrial technological awareness.

This guide is not intended to limit the teacher's class activities but rather to serve as a direction or approach to aid in the development of other guides to meet the needs of the classroom situation. It is hoped that these ideas or suggestions will spark the imagination of teachers so that they will attempt new or innovative ways of interpreting industry at the elementary school level. It is hoped that administrators will provide all staff an opportunity to implement and develop an awareness program in elementary industrial arts.

MIDDLE OR JUNIOR HIGH SCHOOL PLAN
INDUSTRIAL ARTS EDUCATION IN GRADES 7-10

The industrial arts middle or junior high school program is exploratory in nature, and helps students discover and develop individual talents, attitudes, interests and potential related to industry and technology. Through the program, students are oriented both to career opportunities and the working world. Industrial arts students in the orientation and exploration phase do the following:

1. Develop a degree of industrial and technological literacy;

2. Attain knowledge about selecting or making further educational or occupational goals;

3. Improve the competence level in choosing, buying, and using goods and services;

4. Use the tools, equipment, materials and products associated with industry and technology;

5. Play roles in various simulated enterprises in career fields related to industrial arts;

6. Study and analyze the materials, products, processes, problems, uses, developments and contributions of these related career fields;

7. Study the organization of various industries and businesses, and experience typical aspects of many of them; and

8. Research, plan, design, construct and evaluate problems and projects common to various career fields.

It is during this period of time that students learn basic concepts about our industrial-technological society. In the orientation phase (grades 7-8), emphasis is placed on a broad exposure to basic fundamentals of industry and technology and its effects on man, society, and the environment. This course serves as the foundation to illustrate the complexity of industry and the interrelationship of its various events.

In grade 9 and 10, an exploratory cluster approach should be offered. Experiences and activities at this level should enable the student to develop an understanding of the function of industry and the world of work.

This phase is activity-orientated through planned learning experienced in each of the five laboratory cluster areas. Activities are designed to assist the learner in developing proper attitudes, abilities and skills, problem-solving, and understanding of the world of work.

Goal Orientation and Exploration:

The goal of the middle or junior high school level industrial arts program is to assist students in making informed occupational and educational choices.

Description of Orientation Courses: 1 period daily for 90 days.

INDUSTRIAL LITERACY Since one of the predominant characteristics of technology in our society is industrialism, an understanding and appreciation of this aspect of culture with its many implications for school youth is essential. Properly conceived experiences relating to industry constitute a vital part of the common learnings and total development of all youth and will result in industrial literacy.

TECHNOLOGICAL LITERACY The field of industrial education is concerned with the study of the physical, chemical, mechanical, and other forces as related to the materials, processes, machines, and tools of industry and the impact on society and environment. Industrial education programs must emphasize experimentation, problem-solving, construction, development, and production. An understanding of technical concepts and the development of skills relevant to a number of industrial occupations should lead to technological literacy.

Description of Courses: 1 period daily for 90 days

COMMUNICATION The process of sending, receiving, and interpreting messages to satisfy a person's desire for knowledge. Communications technology is the process of encoding, transmitting, receiving, decoding, storing, and retrieving knowledge.

CONSTRUCTION The development and building of a product to be assembled on the site. It includes the whole spectrum of construction technology from management through the production processes.

MANUFACTURING The making of a product that can be moved to a new location for its use. It involves research and development, locating and securing materials, processing these materials into a finished product, and installing and servicing the product in its useful location.

ENERGY/POWER The study of energy sources, transmission and control of these sources, and integrating the effective application of physical sciences and mathematics.

TRANSPORTATION The activity of man concerned with the movement of self, goods, or services from one point in a given environment to another point in the same or alternative environment by some technical means.

HIGH SCHOOL PLAN
INDUSTRIAL ARTS EDUCATION IN GRADES 11-12

Description:

Industrial arts at the senior high school provides pretechnical courses in a unit or general laboratory curriculum. During this preparation sequence, students may begin to concentrate and specialize in selected pretechnical areas. Students may select opportunities for experimentation, problem-solving, application of scientific principles and the integration of physical, chemical and electrical forces dealing with the materials and process of industry.

The program is designed to provide students with a foundation for career preparation at the secondary or post-secondary levels. Students will also gain an adaptability leading to consumer awareness and personal enrichment as well as occupational readiness. The program complements the middle or junior high school curriculum and offers sequential courses without repetition. Through the preparation students will learn to do the following:

1. Provide preoccupational, pretechnical experiences in the technologies of industry;

2. Develop general skills and knowledge for personal, vocational and avocational use;

3. Provide for further assessment of abilities, aptitudes, and interests as they relate to various occupations;

4. Understand industry and its place in society and in the free enterprise system;

5. Understand industrial processes and the practical application of scientific principles;

6. Develop basic skills in the proper use of common industrial tools, materials, and processes;

7. Solve problems involving the materials, processes and products of industry.

Goal Technical Adaptability:

The goal of the high school level industrial arts curriculum is to prepare students for advanced vocational and technical education programs.

Descriptions of Preparation Courses: 1 period daily

PRETECHNICAL Under the direction of specialized teachers, students are provided with basic experiences in drafting, woodworking, electricity-electronics, power, graphic arts, and other areas. From this program, students can obtain experience and guidance on both educational and prospective occupational directions.

POST-SECONDARY PLAN
INDUSTRIAL ARTS EDUCATION IN GRADES 13-17

Description:

Industrial arts education programs at this level contribute to general education and further technical competencies and specialization. Most college programs serve the needs of three distinct groups: (a) prospective teachers, (b) liberal, general, or nontraditional education students, and (c) pretechnical or professional.

The post-secondary industrial arts program attempts:

1. To provide courses needed to augment other instructional areas in the institution including preprofessional, pretechnical and avocational interests;

2. To provide adult and community service programs;

3. To provide laboratory courses in undergraduate work, and professional education courses for initial and in-service training of industrial arts teachers; and

4. To provide basic experiences and understanding for individuals interested in related technologies, such as management, production and technical sales.

Goal Specialization:

The goal of post-secondary industrial arts education programs is to prepare students for technical programs or teacher education.

Description of Specialization Courses: periods vary

POST-SECONDARY SPECIALIZATION Modern society requires more technological preparation before job entry. Some fields or programs of study are very specialized. Community colleges, technical institutes, state colleges, trade schools, universities and industry provide many answers for students to further pursue their occupational or career goals.

SCHEMATIC INTERRELATIONSHIP AND SEQUENCE OF PROGRAMS

AWARENESS	ORIENTATION	EXPLORATION	PREPARATION	SPECIALIZATION
Insights	← Conceptualization →		← Pre-technical →	← Post Secondary
ACTIVITIES INTEGRATED WITHIN CURRICULUM	INDUSTRIAL LITERACY AND TECHNOLOGICAL LITERACY	COMMUNICATION CONSTRUCTION MANUFACTURING ENERGY/POWER TRANSPORTATION	DESIGN-DRAFTING GRAPHIC ARTS CONSTRUCTION WOOD TECHNOLOGY INDUSTRIAL CRAFTS ELECTRICITY/ ELECTRONICS PLASTICS TECHNOLOGY METALS TECHNOLOGY POWER TECHNOLOGY	ENGINEERING PROGRAMS INDUSTRIAL TECHNOLOGY PROGRAMS TECHNICAL INSTITUTES VOCATIONAL-TECHNICAL SCHOOLS APPRENTICESHIP ON-THE-JOB TRAINING TEACHER EDUCATION
Activities	← Laboratory Clusters →		← Unit or General Laboratory →	← Specialized Unit Laboratory
K - 6	7 - 8	9 - 10	11 - 12	13 - 17

ELEMENTARY INDUSTRIAL EDUCATION (K-6)
ACTIVITIES INTEGRATED WITHIN CURRICULUM

ACTIVITY-INTEGRATED CURRICULUM GOALS	EXAMPLES OF EXPECTED OUTCOMES
To develop an increased desire or drive to learn.	As a result of learning experiences at the awareness level, the student will be able to:
To develop an awareness of occupations representative of the industrial/technical world.	Identify and differentiate careers that represent a wide variety of occupations.
To develop awareness into the personal and social significance of work.	Demonstrate a positive attitude toward work as evidenced in good work habits, including preplanning and organizing an activity, respecting the rights of others, and completing a task once it is started.
To foster awareness into the importance of industry in our industrial-technological society.	Describe in general terms the role of industry in contemporary society.
To develop awareness of the systematic process for providing services.	Provide examples of the interdependence of society and industry.
To foster awareness of the evolutionary development of industry and technology.	Describe in general terms a systematic plan for the accomplishment of the production of a marketable product.
To instill recognition of the basic elements of an industrial enterprise.	Describe in general terms how technological advancements have influenced industrial development.
To develop awareness of the influence of technology on society and the environment.	Provide several examples of how advancements in industrial technology have changed our standard of living and system of values.
To develop fundamental psychomotor skills necessary to perform technological tasks.	Identify and briefly describe the major system elements of an industrial enterprise (research and development; production; marketing; and distribution, maintenance, and services).
To develop awareness of the technology and traditional subject matter.	Identify and describe the major coordinating elements of an in-

PROGRAMS: K-6

ACTIVITY-INTEGRATED CURRICULUM GOALS	EXAMPLES OF EXPECTED OUTCOMES
	dustrial enterprise (management and communications). Provide examples of his/her use of technology in the environment. Perform operations using special tools, jigs, fixtures, and machines. Alter the shape of materials using a variety of processes. Correctly and safely use basic tools in the construction of projects or performance of operations related to the manipulation of materials. Manipulate tools and materials in construction activities which reinforce, enrich, motivate, and increase learning related to basic elementary subjects and personal needs.

LEARNING ACTIVITIES FOR ELEMENTARY INDUSTRIAL EDUCATION

Learning activities provide the student with previously-stated opportunities to practice the kind of behavior implied by the goals and objectives. Each teacher should select and develop his/her own activities keeping in mind the emerging concept of industrial arts, the purpose it seeks to achieve and what is known of good pedagogy. The following statements and questions may be helpful in the development of selection of learning activities:

1. The materials should be essentially the same as those actually used in the process of the time and place to be represented.
2. The activity must result in a product that can be utilized, at least for illustrative purposes.
3. Make sure the activity is needed.
4. Ascertain whether or not the activity is educationally sound.
5. Do children have readiness for it in terms of background and skill in construction?
6. Will it contribute to enriched meanings?
7. Will it promote critical thinking, cooperative planning, and problem-solving skills?
8. Is it practical in terms of available time, tools, and materials?
9. Is it more effective than other experiences that can be provided?
10. Will it help to develop accurate concepts?

The following selected learning activities may provide the teacher with some student activities. The intention was to provide an initial bank of ideas. No attempt was made to provide an exhaustive list.

-Use the yellow pages of the phone book to determine what products are produced.

-Read the newspaper ads to learn about locally-manufactured products.

-Interview several of your neighbors and have them explain orally the importance of local industry to their life.

-Identify the common tools and machines from a collection of pictures of tools and machines taken from a sales catalog.

-Discuss the line of authority and responsibility used in an industrial organization in a small-group session; select a group leader and present the group findings to the class.

-Demonstrate physically how raw materials are transformed into end products through participating in a mass-production activity.

-In a small group, construct an example in model form of the type of housing used in a particular period of history.

-Bring in a series of newspaper clippings of examples of man's dependence on technology.

-Establish a simple organizational structure and company name for a class corporation.

-Study the sales catalogs at home and pick out several products which might be produced by the class.

-Develop safe practices in the manipulation of tools and materials.

-Construct a simple model of an early transportation device to be displayed in a group project on transportation.

-Design and construct a puzzle of a cartoon figure.

-Properly assemble wires in a simple buzzer circuit.

-Evaluate commercially-produced products, and list the good and poor factors regarding its design and appearance.

-Write a paper on the role of various community work roles to the happiness of the entire community.

-Participate in a small-group discussion on the value of work in one's life.

PROGRAMS :: 7.10

SCHEMATIC INTERRELATIONSHIP AND SEQUENCE OF PROGRAMS

AWARENESS	ORIENTATION	EXPLORATION	PREPARATION	SPECIALIZATION
Insights ←	→ Conceptualization ←	→ Pre-technical ←	→ Post Secondary	
ACTIVITIES INTEGRATED WITHIN CURRICULUM	INDUSTRIAL LITERACY AND TECHNOLOGICAL LITERACY	COMMUNICATION CONSTRUCTION MANUFACTURING ENERGY/POWER TRANSPORTATION	DESIGN-DRAFTING GRAPHIC ARTS CONSTRUCTION WOOD TECHNOLOGY INDUSTRIAL GRAPHICS ELECTRICITY/ ELECTRONICS PLASTICS TECHNOLOGY METALS TECHNOLOGY POWER TECHNOLOGY	ENGINEERING PROGRAMS INDUSTRIAL TECHNOLOGY PROGRAMS TECHNICAL INSTITUTES VOCATIONAL-TECHNICAL SCHOOLS APPRENTICESHIP ON-THE-JOB TRAINING TEACHER EDUCATION
Activities ←	→ Laboratory Clusters ←	→ Unit or General Laboratory ←	→ Specialized Unit Laboratory	

K - 6	7 - 8	9 - 10	11 - 12	13 - 17

INDUSTRIAL-TECHNOLOGICAL LITERACY GOALS	EXAMPLES OF EXPECTED OUTCOMES
To foster insight into the importance of industry in our industrial-technological society and its place in our culture.	As a result of learning experiences at the orientation level, the student will be able to:
To instill recognition of the basic elements of an industrial enterprise.	Describe in general terms the role of industry in contemporary society.
To develop awareness of the influence and evolutionary development of technology on society and the environment.	Provide examples of the interdependence of society and industry.
To promote insight into technological aspects of communication, construction, manufacturing, transportation, and energy power systems.	Describe in general terms a systematic plan for the accomplishment of the production of a marketable product.
To develop awareness of the interrelationship of technology and traditional subject matter.	Describe in general terms the role of servicing industrial products in our technological society.
To improve proficiencies in selecting, caring for, and using goods and services of industry.	Describe in general terms how technological advancements have influenced industrial development.
To enable students to become familiar with the application of technology to the solution of industrial problems.	Provide several examples of how advancements in industrial technology have changed our standard of living and system of values.
To further develop safe working habits in the use of industrial tools and machines, materials, and processes.	Identify and briefly describe the major system elements of an industrial enterprise (research and development, production, marketing and distribution, maintenance and services).
To improve problem-solving and creative abilities.	Identify and describe the major resource elements of an industrial enterprise (finance, manpower, materials, power and energy, and property).
To develop basic proficiency and psychomotor skills in the use of tools, machines, techniques, and processes.	Identify and describe the major coordinating elements of an industrial enterprise (management and communications).
To increase industrial literacy of technological concepts related to industrial materials, processes, and	

INDUSTRIAL-TECHNOLOGICAL LITERACY GOALS	EXAMPLES OF EXPECTED OUTCOMES
products.	Discuss technological advances with their social and environmental importance.
	Provide examples of his/her use of technology in the environment.
	Identify and correlate sources of energy with their primary use by individuals.
	Select and state techniques for communication.
	Perform operations using special tools, jigs, fixtures, and machines.
	Alter the shape of materials using a variety of processes.
	Correctly and safely use basic tools in the construction of projects or performance of operations related to the manipulation of materials.
	Manipulate tools and materials in construction activities which reinforce, enrich, motivate, and increase learning related to basic elementary subjects and personal needs.
	Apply elements of the traditional subjects to the solution of technological problems and projects.
	List criteria for determination of quality in products produced by industry.
	Demonstrate proficiency in caring for and using the goods and services of industry.
	Relate societal and industrial changes to technology and its development.

INDUSTRIAL-TECHNOLOGICAL LITERACY GOALS	EXAMPLES OF EXPECTED OUTCOMES
	Provide examples of the interdependence of industry and society.
	Describe in general terms the duties of each job function in a typical industrial enterprise.
	Develop a line and staff organizational structure that might be used to staff a student-run industrial enterprise.
	Apply, demonstrate, and exhibit industrial processes and techniques through laboratory experiences such as mass-production, enterprise organization, material-forming processes, and the use of synthetic materials and finishes.
	List the safety requirements of specific tools and machines.
	Relate the safe working practice in the laboratory to situations in the school, home and community.
	Apply, demonstrate, and exhibit scientific, mathematical, and technical principles through the solution of practical problems.
	Solve problems through planning and construction activities occurring in group and individual research, experimentation and development.
	Demonstrate the effective and efficient use of tools and materials.
	Describe in general terms the processing concepts involved in the alteration of selected materials.

INDUSTRIAL AND TECHOLOGICAL LITERACY
BODY OF KNOWLEDGE

*I. INTRODUCTION TO INDUSTRIAL AND TECHNOLOGICAL LITERACY
- A. Defining Industry
  - 1. Definition
  - 2. Purpose
  - 3. Organization
  - 4. Types
- B. History of Industry
  - 1. Home System
  - 2. Craft Guilds
  - 3. Factory System
  - 4. Industrial Revolution
  - 5. Interchangeability of Parts
  - 6. Mass Production
  - 7. Automation
- C. Human Dependence on Industry
  - 1. Home
  - 2. Job
  - 3. School
  - 4. Mobility
- D. Industrial Interdependence
  - 1. Complexity of Products
  - 2. Transportation
  - 3. Energy
  - 4. Subassemblies, Subcontracting
  - 5. Engineering and Measurement Standards
- E. Defining Technology
  - 1. Definition
  - 2. Development of Technology
  - 3. Technology and Industry
  - 4. Technology and Society
- F. Role of the Industrial Arts Laboratory
  - 1. Definition of a Laboratory
  - 2. Simulation
  - 3. Exploration

*II. ELEMENTS OF PRODUCING A PRODUCT
- A. Properties of Materials
  - 1. Hardness
  - 2. Brittleness
  - 3. Weight
  - 4. Flexibility
  - 5. Heat Conductivity
- B. Use of Common Industrial Materials
  - 1. Woods
  - 2. Plastics
  - 3. Ferrous Metals
  - 4. Nonferrous Metals
  - 5. Paper
  - 6. Compositions
  - 7. Alloys
  - 8. Textiles

9. Ceramics
10. Glass
11. Concrete
12. Rubber

C. The Five Types of Industries
1. Manufacturing
2. Construction
3. Energy/Power
4. Communication
5. Transportation

D. Sketching and Design Drafting
1. Freehand Sketching (Orthographic)
2. Freehand sketching (Isometric)
3. Alphabet of Lines
4. Geometrics
5. Drafting Instruments
6. Plate Layout
7. Centering
8. Lettering
9. Sample Orthographic Plates
10. Dimensioning (Metric)
11. Design a Project to be Constructed

*III. PROCESSES

A. Safety
1. Personal Safety
2. Participants' Safety

B. Planning
1. Layout
2. Estimating
3. Measuring

C. Tool Identification and Use

D. Forming
1. Casting or Molding
2. Compressing or Stretching
3. Conditioning Material

E. Separating
1. Shearing
2. Clip Removing
3. Other Processes

F. Combining
1. Mixing
2. Coating
3. Bonding
4. Mechanical Fasteners

*IV. INDUSTRIAL RESOURCES

A. Kinds of Raw Materials
1. Mineral Fuels
2. Non-metallic Minerals
3. Metallic Minerals

B. Extraction
1. Surface Mining
2. Underground Mining
3. Drilling

C. Reproducible Materials
    1. Plant and Animal Sources
D. Nonrenewable Materials
    1. All other Material Sources
    2. Recycling
    3. Conservation of our Resources
E. Types of Energy
    1. Mechanical
    2. Radiant
    3. Chemical
    4. Heat
    5. Electrical
    6. Nuclear
F. Human-made Materials (Synthetics)
G. Converting Raw Materials
    1. Preparation for Refining
    2. Refining
    3. Controlling Quality
    4. Bulking
    5. Converting
H. Durable and Non-durable (Materials)

**V. ORGANIZATION OF INDUSTRY
A. Ownership of Industry
    1. Private
    2. Cooperative
    3. Public
B. Personnel of Industry
    1. Managerial
    2. Labor (Non-managerial)
C. Collective Bargaining
    1. Laws
    2. Employers
    3. Employees
    4. Grievance Procedures
D. Types of Industries
    1. Manufacturing
    2. Construction
    3. Graphic Communication
    4. Energy/Power
    5. Transportation
E. Human Needs
    1. Physical Needs
    2. Security Needs
    3. Love Needs
    4. Esteem Needs
    5. Self-fulfillment Needs
F. Career Needs
    1. Educational Requirements
    2. Working Conditions
    3. Location of Work
    4. Regularity of Work
    5. Working Hours
    6. Chances of Advancement

**VI. MASS PRODUCTION

**VI. MASS PRODUCTION
- A. Standardization of Parts
- B. Terminology of Mass Production
- C. Elements of Mass Production
  1. Research and Development
  2. Purchasing
  3. Lead Time
  4. Tooling Up
  5. Assembly and Subassemblies
- D. Quality Control and Craftsmanship

***VII. MARKETING OF PRODUCTS
- A. Advertising
  1. Graphics
  2. Communications
  3. Profits
- B. Packaging
  1. Package Fabrication
  2. Package Graphics
  3. Transportation
  4. Displaying
- C. Sales
  1. Industry to Industry
  2. Consumer Direct
  3. Wholesalers
  4. Retailers
- D. Consumer Relations
  1. Serviceability
  2. Warrantees
  3. Guarantees

**VIII. SOCIAL AND ENVIRONMENTAL IMPACT
- A. Quality of Life
  1. Job Life
  2. Advancements
- B. Government Regulations
  1. OSHA Requirements
  2. Environmental Protection Agency
  3. Compulsory Retirement
- C. Living Conditions
  1. Home Life
  2. Crowded Conditions
  3. Mass Transportation

*This is the recommended first 90-day segment.

**This is the recommended second 90-day segment.

COMMUNICATION GOALS	EXAMPLES OF EXPECTED OUTCOMES
Experiences and activities will enable the student to:	
Compare the merits and weaknesses of numerous types of composition and printing processes.	Collect examples of composition from different types of composition machines and critique their weaknesses and values.
Recognize basic reproduction processes used in industrial applications of technical graphics.	Identify reproductions produced by various processes.
Use properly the nomenclature associated with communications.	Use properly the terminology associated with graphic communications in daily conversation within the laboratory.
Interpret selected standardized drafting symbols when they are presented in the form of a drawing.	Produce a cardboard or styrofoam model from a dimensioned drawing.
Compare the occupational requirements and benefits for the following areas of communications: research and development, design, drafting, electronic graphic reproduction and packaging.	Answer questions pertaining to a drawing when presented with a print.
Compare and contrast the industrial applications of the basic printing processes.	Have each member of the class interview two employees in one of the areas of graphic communications, the similarities and differences in job requirements and benefits.
Demonstrate the interrelationship of photography with drafting and graphic arts as used in industry.	Identify at least fifteen industrial occupations in the communications cluster.
Interpret the strength and weaknesses of the design and production of an industrial product.	Play "Twenty Questions" with some students picking an occupation and the other members of the class asking questions, attempting to identify the occupation.
Demonstrate proper use of the four primary printing processes.	Prepare a display using examples of the basic printing processes.
Identify the materials, processes and equipment used in communications.	Produce a photodrawing.
	Produce a film positive halftone for silk screening.

COMMUNICATION GOALS	EXAMPLES OF EXPECTED OUTCOMES
Produce continuous-tone photographic positives and negatives.	Produce copies using image production processes generally found in business and offices.
Apply basic processing concepts of photography.	Discuss the primary responsibilities of those necessary to the production of a printed document in industry.
Demonstrate a knowledge of how to assemble printed material.	Hold a small-group discussion regarding the production of a printed document in industry resulting in the making of a flow chart showing a document's route.
Demonstrate effective means of conveying an idea using presentation materials.	Develop a roll of black and white film.
Apply the principles of communications to produce a package for a product.	Strip a flat.
Apply the principles of design to a given problem.	Burn a plate.
Apply the theories of visual organization.	Divide the class into small groups and establish a corporate structure. Design a product, assigning individual responsibilities according to the design phase of the product.
Produce sketches and drawings following standardized procedures capable of being used to produce a product.	Prepare a photo silk screen for printing a package design.
	Prepare business cards for the management of a class "corporation."
	Duplicate with an offset duplicator presentation materials for a product.
	Produce a set of ink color patches to demonstrate mixing inks.
	Produce an ortho photograph of line copy.
	Construct and display methods of communication.
	Construct the origins of alphabets.
	Construct communications model in classroom.

COMMUNICATION GOALS	EXAMPLES OF EXPECTED OUTCOMES
	Discuss the future of communications.
	Shoot and print pictures of members of a class "corporation" and prepare them to be used as identification badges.
	Prepare a microfilm copy of a drawing.
	Prepare line negatives for stripping of an offset plate.
	Construct a chart showing the history of relief type.
	Produce samples of paper and handcut silkscreen stencil projects.
	Bring in sample of a gravure printed product.
	Produce a sample of an offset project.
	Print a roll of black and white film.
	Bring a sample of printing for electrostatic systems.
	Produce a note pad for the members of a class design team.
	Prepare an instruction or assembly booklet for a product.
	Flat and saddle stitch a booklet.
	Construct a pad using a perfect binding method.
	Produce a booklet using a plastic ring binder.
	Make a product design idea presentation to the class.
	Prepare a phototype package for a

COMMUNICATION GOALS	EXAMPLES OF EXPECTED OUTCOMES
	designed product.
	Given a problem, design a satisfactory solution employing the principles of design.
	Given a specific product, design an advertisement to portray the product in a popular magazine.
	Draw a freehand sketch using proper sketching techniques to depict an idea.
	Properly produce sketches in connection with other design problems.
	Draw production drawings from prototypes and design sketches.
	Critique the design of a product from the home, indicating its weaknesses and merits.
	Produce examples of each of the common types of orthographic and pictorial representatives and list applications for each type.
	Collect examples of poor design and hold a class discussion regarding students' reaction toward the examples shown.
	Conduct radio tape interviews with a classmate (each student interviewing another student). Explain how you feel about "your" job and its importance to the total communications cluster.
	State a positive attitude towards a possible career in some aspect of communications.
	Identify drawings used by various industries.
	Student will produce production

COMMUNICATION GOALS	EXAMPLES OF EXPECTED OUTCOMES
	drawings.
	Produce plates demonstrating typical lines and letters.
	Reproduce a drawing by the Graph Method.
	Give reports (oral) on influential draftsmen and designers.
	Write a paper on: "What job would I like to have in the communications field?"

COMMUNICATIONS
BODY OF KNOWLEDGE

I. COMMUNICATION
- A. Communication and Man
  - 1. Evolution of Communication
  - 2. Communication Model
  - 3. Social Impacts of Communication
  - 4. Cultural Impacts of Communication
- B. Communication and Technology
  - 1. Origins of the Graphic Reproduction Industry
  - 2. The Middle Ages and Industrial Revolution
  - 3. Graphics to the Present
  - 4. The Future of Graphic Communications

II. FREEHAND
- A. Basic Procedures
  - 1. Tools
  - 2. Lines
  - 3. Lettering
- B. Graph Methods
  - 1. Enlarged
  - 2. Reduced
  - 3. Copy
- C. Orthographic
  - 1. Thumbnail
  - 2. One View
  - 3. Multiview
  - 4. Working
- D. Pictorials
  - 1. Isometric
  - 2. Oblique
  - 3. Perspective
- E. Impact on Society
  - 1. Artistic
  - 2. Technical
  - 3. Recreational

III. INSTRUMENT
- A. Basic Procedures
  - 1. Tools and Equipment
  - 2. Techniques
  - 3. Alphabet of Lines
  - 4. Geometric Construction
  - 5. Lettering
- B. Orthographic
  - 1. Theory of Shape Description
  - 2. Dimensioning
  - 3. Scale Drawing
  - 4. Types
- C. Pictorial
  - 1. Isometric
  - 2. Oblique

3. Perspective
4. Presentation

D. Reproduction
1. Blueprint/Whiteprint (Diazo)
2. Xerox
3. Microfilm
4. Computer
5. Photographic

E. Industrial Impact on Society
1. Aerospace
2. Architectural
3. Charts and Graphs
4. Electrical
5. Engineering
6. Map
7. Metal

IV. DESIGN

A. Message Analysis
1. What is the message?
2. Why send a message?
3. To who--what class of people?
4. When?
5. How?
6. Where?

B. Layout
1. Topography
2. Drafting the Layout

V. IMAGE GENERATION

A. Hot Type
1. Metal Type
2. Cold Type

VI. PRE-PRODUCTION

A. Material
1. Inks
2. Paper

B. Process
1. Proofreading
2. Film Types
3. Stripping
4. Plate Making
5. Presses

VII. PRODUCTION

A. Relief
1. Letterpress

B. Stencil
1. Paper
2. Handcut
3. Photographic

C. Intaglio
1. Intaglio Process

2. Intaglio Image Carriers
3. Intaglio Press

D. Offset
1. Offset Process
2. Offset Press
3. Press Operations

E. Continuous Tone Photograph
1. Black and White
2. Color

F. Electrostatic

VIII. BINDERY

A. Binding
1. Folding
2. Cutting
3. Drilling
4. Gathering
5. Methods

B. Finishing, Packaging and Distribution
1. Finishing a Book
2. Packaging
3. From Bindery to Customer

IX. ELECTRONIC COMMUNICATION

A. Relationship to Communications Model

B. Process
1. Power Supply
2. Amplification
3. Oscillators
4. Switching

C. Study of One-Way Communications System
1. Radio
2. Phonograph
3. Television
4. Tape Recording

D. Study of Two-Way Communications Systems
1. Telegraph
2. Telephone
3. Radar
4. Satellites
5. Computer
6. Tape Recording

E. Telecommunications Careers
1. Community Resources
2. Community Telecommunications Industries

X. CAREERS

A. Classification
1. Management
2. Labor

B. Career Opportunities in the Industry
1. Preparation
2. Economics
3. The Future

JUNIOR HIGH SCHOOL INDUSTRIAL EDUCATON (7-10)
CONSTRUCTION

CONSTRUCTION GOALS	EXAMPLES OF EXPECTED OUTCOMES
As a result of the study of this course in construction, the student will:	
Describe the fields in construction and specific occupations therein.	Visit a construction site at various stages and list the components which were prefabricated in an industrial plant.
Read and apply information from a mechanical or working drawing.	Make a list of symbols, scales, and commonly-used methods to communicate ideas in construction.
Explain and demonstrate sketching, pictorial drawing, schematic drawing, and architectural drawing.	Make a priority listing of factors considered essential to the location of the student's future home.
Demonstrate an understanding of masonry skills.	List common masonry materials and tools used in foundation construction. Use common masonry terms in describing the process to the instructor.
Develop a knowledge of career opportunities in construction.	Obtain and analyze plumbing, heating, and air conditioning specs.
Briefly explain the development of a community.	Participate in construction of a house module, garage, or similar structure using various framing techniques.
Demonstrate ability to apply knowledge of plumbing, heating, electrical and air conditioning as they relate to construction.	Study the NEC and local electrical code, then inspect an installation.
Exhibit a willingness to solve the technical problems relating to construction technology.	Assist in installing mechanical and electrical devices in a module or actual building.
Gather data dealing with the fact that today's worker may have to change jobs a number of times during his/her working career.	Analyze actual construction estimates. Develop an estimate of a selected construction job.
	Select some jobs that are interesting and make a study of preparation needed for them.
	Select a suitable plot for a possible construction project, survey it, and make a plot plan.
	Plan and perform skills relating to plumbing, heating, electrical and air conditioning construction.

CONSTRUCTION
BODY OF KNOWLEDGE

I. INTRODUCTION TO CONSTRUCTION TECHNOLOGY
   A. Construction Technology
      1. Construction Management
      2. Construction Personnel
      3. Construction Processes
      4. Construction Materials
   B. History of Building Construction
      1. Development of Architectural Styles
      2. Post and Lintel
      3. Arch
      4. Vault
      5. Dome
      6. Truss
      7. Frame
   C. Construction Materials
      1. Concrete
      2. Metal
      3. Wood
      4. Synthetics
      5. Others
   D. Applying Construction Technology to People
      1. Construction Technology Careers
      2. Advancing in Construction
   E. Construction Technology and The International System of Measurement
      1. Introduction to Measurement
      2. Measurement in the United States
      3. Systems International Units of Measure
      4. Prefixes
      5. Drawing to Scale
      6. SI Scales for Construction and Map Drawing
      7. Useful Conversions
   F. Construction Technology and Safety
      1. Introduction to Safety
      2. Personal Protective Equipment
      3. Scaffolds

II. PRE-CONSTRUCTION
   A. Beginning the Project
      1. Selecting the Site
      2. Buying Real Estate
      3. Surveying and Mapping
      4. Soil Testing
   B. Designing and Engineering the Project
      1. Identifying Design Problems
      2. Analyzing the Design
      3. Designing and Engineering Cycle
      4. Energy Usage, Conservation and Ramifications Related to Construction
   C. Selecting the Builder

1. Contracting
2. Estimating and Bidding
3. Scheduling

III. CONSTRUCTION
- A. Getting Ready to Build
  1. Clearing the Site
  2. Locating the Structure
  3. Earth Moving
  4. Stabilizing Earth and Structures
- B. Classifying Structure
  1. Setting Foundations
  2. Building Forms
  3. Setting Reinforcements
  4. Mixing Concrete
  5. Placing and Finishing Concrete
  6. Completing Foundations
  7. Building Superstructures
  8. Building Mass and Masonry Superstructures
  9. Building Wood Frames
  10. Installing Utilities
  11. Enclosing Framed Superstructures
  12. Finishing the Project
- C. Completing the Site

IV. POST-CONSTRUCTION
- A. Servicing the Property
- B. Transferring the Project

MANUFACTURING GOALS	EXAMPLES OF EXPECTED OUTCOMES
Experiences and activities in this course will enable the student to:	
Identify the raw materials necessary to the manufacture of named products.	Investigate how iron ore is converted to steel.
Identify the different methods of separating, forming, machining, assembling, and finishing materials.	List examples of methods of forming, machining, finishing, and assembling materials.
Describe the need for tooling in mass production and automation.	Participate in a variety of experiences which involve shearing, forming, machining, assembling, and finishing varius types of materials.
Describe the need for production quality control.	Develop an operation and flow diagram for mass producing and assembling an item.
Exhibit basic knowledge of career opportunities in the manufacturing field.	List how different materials are cut, bent, and fastened together.
Employ responsible and safe work attitudes and be able to function as a member of a group.	Identify the tooling needs for mass producing an object, and differentiate between the needs for mass production and custom production.
Design products for construction in the laboratory using mass and custom production.	Investigate jobs from various sources; i.e., printing literature, industrial visitations and interviews.
Analyze industrial technical occupations in specific industries and career clusters.	Simulate job interviews in the classroom.
Compare and contrast the common job activities of several industries in a common industrial cluster.	Write letters of job applications.
Develop knowledge in a particular industrial cluster which may lead to employment and/or future education.	Diagram a management system necessary for constructing a previously manufactured prototype.
Describe how the elements of industry and management practices relate to the manufacture of goods and products in industry.	Participate in a simulation of controlled production.
	Practice measuring selected objects with English and Metric systems.

MANUFACTURING GOALS	EXAMPLES OF EXPECTED OUTCOMES
Solve simulated industrial manufacturing problems in a safe and efficient manner.	View industrial safety films.
Exhibit a degree of creativity in the design and manufacture of industrial products.	Practice good safety habits and attitudes.
Evaluate manufactured projects and products in terms of quality of construction.	Make a product that involves cutting, bending, and assembling.
Display proficiency in functioning as an intelligent consumer in the selection, purchase, use, and maintenance of the goods and services of industry.	Diagram a management system necessary for constructing a previously manufactured prototype.
Describe the application of significant advances in technology to processes and techniques currently used in a specific industry.	
Demonstrate proficiency in the use of tools, machines, and materials of a selected industry in a safe and efficient manner.	
Apply the processes of industry to the successful production of goods or services.	
Apply technology to the solution of problems related to the production of goods or the rendering of a service.	

MANUFACTURING
BODY OF KNOWLEDGE

I. ELEMENTS OF MANUFACTURING INPUT
   A. Market
      1. Demand
      2. Supply
   B. Resources
      1. Human
      2. Materials
      3. Capital
   C. Product Development
      1. Engineering
      2. Designing

II. ELEMENTS OF MANUFACTURING
   A. Pre-Processes
      1. Market Survey
      2. Tooling up for Production
      3. Production Prototype
   B. Processing
      1. Casting
      2. Forming
      3. Subtractive
      4. Fab/Assembly
      5. Finishing
   C. Post-Processing
      1. Quality Control
      2. Packaging
      3. Dissemination
      4. Recycle

III. ELEMENTS OF MANUFACTURING OUTPUT
   A. Nondurable Goods
   B. Durable Goods

IV. MASS PRODUCTION AND AUTOMATION
   A. Standardization
   B. Tools and Machines
      1. Jigs
      2. Fixtures
   C. Material Handling
   D. Assembly Systems
   E. Lead Time and Profit
   F. Automation
   G. Safety

V. PRIMARY METALS INDUSTRY
   A. Refining Iron
      1. Raw Materials
      2. Blast Furnace
      3. Cast Iron
   B. Steel

1. Open Hearth Furnace
2. Electric Furnace
3. Basic Oxygen Furnace
4. Pouring Ingot
5. Continuous Casting
6. Rolling Mills

C. Nonferrous Metals
1. Aluminum
2. Copper
3. Lead
4. Tin
5. Zinc

D. Alloying

E. Testing and Research

VI. CASTING METAL
A. Patterns and Patternmaking
B. Core and Core Making
C. Machine Molding
D. Casting Processes
1. Green and Casting
2. Die Casting
3. Contrifuged Casting
4. Investment Casting
5. Shell Molding
6. Plaster Mold Casting

E. Cleaning and Finishing

VII. FORMING METAL
A. Forging
B. Extrusion
C. Powder Metallurgy
D. Shearing
E. Drawing
F. Bending
G. Roll Forming
H. Spinning
I. High Energy Rate Forming

VIII. MEASURING AND LAYOUT (ENGLISH AND/OR METRIC)
A. Linear Dimension
B. Angular Dimension
C. Surface Dimension

IX. MACHINING METAL
A. Sawing
B. Turning
C. Milling
D. Shaping
E. Drilling
F. Grinding
G. Recent Techniques

X. FASTENING AND FINISHING METAL
- A. Welding
- B. Brazing
- C. Soldering
- D. Heat Treating
- E. Adhesive Bonding
- F. Sheet Metal Assembly
- G. Mechanical Fasteners
- H. Polishing and Buffing
- I. Coatings

XI. LUMBERING AND FOREST PRODUCTS
- A. Characteristics
- B. Classifications
  - 1. Hardwoods
  - 2. Softwoods
- C. Lumbering
  - 1. Sawing
  - 2. Seasoning
  - 3. Surfacing
  - 4. Grading
- D. Plywood
- E. Hardboard
- F. Particle Board

XII. CUTTING AND SHAPING WOOD
- A. Planing
- B. Sawing
- C. Drilling and Boring
- D. Turning
- E. Routing and Shaping
- F. Sanding
- G. Bending and Laminating

XIII. ASSEMBLING AND FINISHING WOOD
- A. Wood Joints
- B. Adhesives
- C. Mechanical Fasteners
- D. Assembly Procedures
- E. Wood Finishes

XIV. PLASTIC MATERIALS AND PROCESSES
- A. Classification
  - 1. Thermoplastic Plastic
  - 2. Thermosetting Plastic
- B. Molding
  - 1. Compression
  - 2. Transfer
  - 3. Injection
  - 4. Plastic Foam
  - 5. Blow
- C. Extrusion
- D. Thermoforming
- E. Casting
- F. Fabricating and Finishing

XV. CAREER OPPORTUNITIES IN MANUFACTURING

- A. Levels of Employment
  1. Professional
  2. Skilled
  3. Semi-skilled
  4. Unskilled
- B. Personnel Practices
  1. Recruiting
  2. Hiring
  3. Training
  4. Working
  5. Advancement
  6. Retirement
- C. Outlook

ENERGY/POWER GOALS	EXAMPLES OF EXPECTED OUTCOMES
Experiences and activities in this course will enable the student to:	Form a flow chart of a chosen power related industry.
Identify and design an organizational structure of man and machine for a typical energy/power industry.	Prepare and present a technical report.
Identify and distinguish between the common methods of energy/power conversion, transmission, and consumption.	Trace the power flow of electricity production through consumption in the home.
Demonstrate skills and techniques in class useful for general maintenance and repair of energy and power devices.	Trace power flow through an automobile.
Be familiar with the use of basic components for developing, transmitting, and controlling power.	Outline a student's daily dependence on various sources of energy/power in a typical day.
List and describe the main job requirements for a career in one of the occupations related to the power and energy field.	Visit a power generating plant and identify possible environmental problem areas.
Describe a variety of basic processing and job skills related to occupations in the power and energy fields.	Experiment with various electrical producing devices.
Identify in verbal discussion or writing the clusters of jobs related to power conversion and use.	Interview a power and energy worker and summarize job entrance requirements from this interview.
Manipulate an apparatus for demonstrating energy sources, conversion, transmission, and consumption of power.	Survey the local community and list specific jobs related to the energy field.
Apply knowledge and skills toward converting power.	Construct small model rockets and demonstrate their use.
Operate basic test and measuring devices used in energy systems.	Construct an experimental battery.
	Write a program for personal conservation of energy.

ENERGY/POWER GOALS	EXAMPLES OF EXPECTED OUTCOMES
Identify high school and post-high school training programs in energy/power.	
Organize and list in order criteria for choosing and buying power devices.	
Relate how technology can solve a problem while creating other problems.	
Display personal and group safety when working around energy/power systems.	

ENERGY/POWER
BODY OF KNOWLEDGE

I. ENERGY/POWER INTRODUCTION CONCEPTS
   A. The Energy Tree (Sun as Origin)
      1. Light - Heat
      2. Chemical Reaction - Vegetation
      3. Chemical Reaction - Fossil Fuels, etc.
      4. Conservation and Research
   B. Two Basic Energy Types
      1. Kinetic
      2. Potential
   C. Historical Harnessing and Energy Uses
      1. Muscle Power
      2. Water and Wind
      3. Heat and Steam
      4. Gravity
   D. Basic Measurements, Basic and Derived Units, and Interrelationships
      1. Energy (Joule)
      2. Power (Watt)
      3. Force (Newton)
      4. Torque (Newton Meter)
      5. Pressure (Pascal)
      6. Thermal Energy (Calorie)
      7. Mass, Length, Time, etc.

II. ENERGY/POWER SAFETY CONCEPTS
   A. Hazards
      1. Chemical
      2. Electrical
      3. Mechanical
      4. Radiation (Light and Nuclear)
      5. Thermal
   B. Preventive Measures
      1. Attitudes
      2. Knowledge of Correct Usage
      3. Equipment
      4. Facilities
   C. Protective Measures
      1. Apparel
      2. Containering Methods
      3. Shielding (Eyes, Face, Insulative, etc.)
      4. Grounding and/or Appropriate Mounting
   D. Corrective Measures
      1. Extinguishers
      2. Inhibitors
      3. Neutralizers

III. ENERGY FORMS AND SOURCES
   A. Chemical
      1. Fossil Fuels
      2. Biofuels

B. Electrical
   1. Electrostatic
   2. Magnetic
C. Light
   1. Solar
   2. Radioactive
D. Mechanical
   1. Wind
   2. Water
   3. Gravitational
E. Nuclear
   1. Atomic, Radioactive
   2. Solar
F. Thermal
   1. Geothermal
   2. Solar
   3. Cryogenic (Super Cold)

IV. ENERGY HARNESSING SYSTEMS AND NEWTON'S LAWS
A. Nonconversion, Direct Conversion, and Indirect Conversions
   1. Law of Conservation of Energy
B. Chemical Energy Input
   1. Fuel Cell
   2. Batteries
   3. Fusion
   4. Fission
   5. Sun
   6. Chemical Heaters
   7. Internal Combustion Engines
   8. External Combustion Engine
   9. Chemical Explosives
C. Mechanical Energy Input
   1. Pneumatic Driven
   2. Hydraulic Driven
   3. Pexioelectric Effect
   4. Electric Generator and Alternators
D. Electrical Energy Input
   1. Motors
   2. Selenoids
   3. Speakers
   4. Nichrome Wire Heating Element
   5. Crystal
   6. Radio
   7. Television
   8. Heaters
   9. Lights
   10. Refrigerator Systems
   11. Laser
   12. Light Emitting Diode (LED)
   13. Vacuum Tubes
   14. Semiconductors
   15. Magnetohydrodynamic Generator
   16. Microwave Ovens

17. Etc.

E. Nuclear Energy Input
   1. Nuclear Reactors
   2. Radioactive Isotopes
   3. X-rays
   4. Nuclear Battery

F. Thermal Energy Input
   1. Thermostat
   2. Thermocouple (Thermoelectric Generator)
   3. Thermoinic Device
   4. Boiling (Water/Steam)
   5. Heat Radiation
   6. Thermophotovoltaic Converter (TPV) - Solar Dwelling

G. Light Energy Input
   1. Photovotaic Cell (Solar Cell)
   2. Photoconductive Cell
   3. Photosynthesis (Solar Dwelling)

V. ENERGY/POWER STORAGE, TRANSMISSION AND CONTROL

A. Storage of Energy
   1. Monentary
   2. Temporary

B. Media of Transmission
   1. Electrical Energy
   2. Light Energy
   3. Thermal Energy
   4. Mechanical Energy
   5. Chemical Energy
   6. Nuclear Energy

C. Control Systems
   1. Sensing and Sensors (for control purposes)

VI. ENERGY/POWER UTILIZATION
(Emphasis on safe, efficient and conservative use in all of the below indicated applications.)

A. Residential
   1. Light Energy
   2. Thermal Energy
   3. Mechanical Energy
   4. Nuclear Energy

B. Commercial (Services and Products are Distributed)
   1. Light Energy
   2. Thermal Energy
   3. Mechanical Energy
   4. Nuclear Energy

C. Industrial (Products are Produced)
   1. Light Energy
   2. Thermal Energy
   3. Mechanical Energy
   4. Nuclear Energy

D. Transportation
   1. Air or Space

2. Surface
3. Water

VII. ENERGY/POWER CAREER OPPORTUNITIES
(Emphasis on duties, responsibilities, main job requirements and training programs--and including the concept of intercategory assignments; i.e., the technician can contribute skills in the areas of servicing, research and development, maintenance, etc.)

A. Professional
   1. Engineer/Designer
   2. Inventor
   3. Researchers/Scientists
   4. Educators
   5. Executives/Managers

B. Technical
   1. Quality/Production Supervisor
   2. Engineering Assistant
   3. Superintendent/Foreman
   4. Drafting/Design Personnel
   5. Experimental Personnel

C. Skilled
   1. Electricians
   2. Assemblers
   3. Machinists

D. Semi-Skilled
   1. On-the-Job Trainees
   2. Self-Improved Workers

E. Unskilled
   1. Helpers
   2. Laborers
   3. Attendants

TRANSPORTATION GOALS	EXAMPLES OF EXPECTED OUTCOMES
As a result of the study of transportation, students:	Students identify and compare occupations and careers related to transportation.
Exhibit insights and understandings of transportation as used in our society.	Students select more realistic educational programs and occupational goals for the next grade levels.
Identify interests and develop capabilities related to the utilization of transportation.	Students will be able to discuss methods of transporting people and goods.
Be able to define transportation and what is transported.	Students will be able to discuss how space transportation relates to and coincides with other modes of transportation.
Will be able to develop problem-solving techniques concerned with materials, equipment, and personnel in the transportation industry.	Discuss modern design and materials used in construction of transportation modes.
Develop an awareness of career opportunities available in the area of transportation technology.	Calculate the cost of moving people and goods using different transportation modes.
Identify the four major components of transportation.	Discuss packaging, material handling, return goods handling, traffic and transportation, warehousing and the flow of materials to point of consumption.
List more than eight methods of transportation.	
Describe physical distribution management of internal and external industrial transportation.	

TRANSPORTATION
SUGGESTED INSTRUCTIONAL UNITS

I. HOW TRANSPORTATION HAS CHANGED
   A. Past
   B. Present
   C. Future

II. TRANSPORTATION TERMINOLOGY
   A. Vehicles
      1. Designs
      2. Types
   B. Power Plants - Power the Vehicle
      1. Propulsion Types
   C. Controls - Steering
      1. Direction, Altitude, Velocity
   D. Routes
      1. Land, Water, Air, Aerospace

III. PIPELINES
   A. Vehicles
      1. Designs
      2. Structures
   B. Power Plant
      1. Mechanical
      2. Natural
   C. Controls
   D. Routes

IV. CONVEYORS
   A. Vehicles
      1. Designs
      2. Structures
   B. Power Plants
      1. Propulsion
   C. Controls
   D. Routes

V. AUTOMOBILE/TRUCKS
   A. Vehicles
      1. Designs
      2. Research
   B. Power Plants
      1. Propulsion
   C. Controls
   D. Routes
      1. Research

VI. TRAINS
   A. Vehicles
      1. Designs
      2. Future
   B. Power Plants

1. Propulsion
C. Controls
D. Routes
1. Future

VII. AIRPLANES
A. Vehicles
1. Passenger
2. Cargo
3. Military
B. Power Plant
1. Propulsion Types
C. Controls
D. Routes

VIII. SPACE VEHICLES
A. Vehicles
1. Designs
B. Power Plant
C. Controls
D. Routes

IX. SHIPS
A. Vehicles
1. Cargo
2. Passenger
3. Military
B. Power Plant
C. Controls
D. Routes

X. RECREATIONAL TRANSPORTATION
A. Land
1. Snowmobiles
2. Cycles
B. Air
1. Balloons
2. Gliders
C. Water
1. Boats
2. Surfboards

XI. CAREERS IN TRANSPORTATION
A. Research Designs
B. Support Systems
C. Operations

PROGRAMS: 11 • 12

SCHEMATIC INTERRELATIONSHIP AND SEQUENCE OF PROGRAMS

AWARENESS	ORIENTATION	EXPLORATION	PREPARATION	SPECIALIZATION
Insights ←→	Conceptualization ←→		Pre-technical ←→	Post Secondary
ACTIVITIES INTEGRATED WITHIN CURRICULUM	INDUSTRIAL LITERACY AND TECHNOLOGICAL LITERACY	COMMUNICATION	DESIGN-DRAFTING GRAPHIC ARTS	ENGINEERING PROGRAMS INDUSTRIAL TECHNOLOGY PROGRAMS
		CONSTRUCTION	CONSTRUCTION WOOD TECHNOLOGY	TECHNICAL INSTITUTES
		MANUFACTURING	INDUSTRIAL CRAFTS	VOCATIONAL-TECHNICAL SCHOOLS
		ENERGY/POWER	ELECTRICITY/ ELECTRONICS	APPRENTICESHIP
		TRANSPORTATION	PLASTICS TECHNOLOGY METALS TECHNOLOGY POWER TECHNOLOGY	ON-THE-JOB TRAINING TEACHER EDUCATION
Activities ←→	Laboratory Clusters ←→		Unit or General Laboratory ←→	Specialized Unit Laboratory
K - 6	7 - 8	9 - 10	11 - 12	13 - 17

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
DESIGN/DRAFTING

Rationale:

A study of design/drafting, within graphic communications, provides an opportunity for a concentrated and specialized study of drafting in industry. An atmosphere is provided for all students to develop pretechnical skills and knowledge into the economic, social, and technological aspects of visual communications in a changing society.

Design/drafting involves students in meaningful instructional activities and develops self-direction, continuous learning and creativity.

DESIGN/DRAFTING
SUGGESTED INSTRUCTIONAL UNITS

*I. Introductions and History to Drafting
*II. Review of South Dakota Industrial Education Curriculum Guide for Graphic Communications Technology
*III. Geometric Construction
*IV. Orthographic Projection
*V. Dimensioning (English and SI Metric)
*VI. Pictorials
*VII. Sections and Conventions
*VIII. Auxiliary Views
*IX. Working Drawings
X. Charts and Graphs

*Recommended units of instruction for an 18-week course.

CONSTRUCTION DRAFTING
SUGGESTED INSTRUCTIONAL UNITS

I. Introduction to Construction Drafting
II. Review of Drafting Procedures
III. Building Codes and Office Practices Used
IV. Plot or Site Plans
V. Floor Plans and Utility Planning
VI. Foundation Plans
VII. Elevations
VIII. Construction Sections
IX. Construction Details
X. Presentation Drawings
XI. Career Opportunities in Construction Drawing

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
GRAPHIC ARTS

Rationale:

This program course is designed to provide instruction in competencies common to a cluster of occupations in graphic arts industries and to develop skills, knowledge and attitudes for success and advancement in a specialized occupational proficiency program.

Instruction provides for basic competency development in the following areas: graphic reproduction using the tools, materials and processes of the printing industry. Learning experiences include designing, composing, printing, photography, and reproduction techniques.

SUGGESTED INSTRUCTIONAL UNITS

*I. REVIEW THE SOUTH DAKOTA INDUSTRIAL ARTS CURRICULUM GUIDE FOR COMMUNICATIONS TECHNOLOGY

*II. DESIGN PRINCIPLES
- A. Message Analysis
- B. Design
- C. Layout

*III. METHODS OF IMAGE GENERATION

*IV. INTRODUCTION TO PHOTOGRAPHY
- A. Photographic Principle and Theory
- B. Photographic Equipment and Materials Selection
- C. Lighting, Taking Picture, and Film Exposure
- D. Photographic Laboratory Safety
- E. Film Development and Making Prints

*V. PREPRODUCTION METHODS

*VI. PRODUCTION
- A. Relief
- B. Offset
- C. Gravue
- D. Screen
- E. Duplicating

*VII. JOB PLANNING AND ESTIMATING

IX. CHARACTERISTICS AND MANUFACTURING OF MATERIALS USED IN GRAPHIC ARTS

X. REPROGRAPHICS PROCESS TROUBLE SHOOTING

XI. GRAPHIC ARTS PLANT OPERATION

XII. CAREER OPPORTUNITIES

*Recommended units of instruction for an 18-week course.

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
CONSTRUCTION

Rationale:

Students design, build and test model structures. Students work with projects that help them to understand the jobs of architects, carpenters, electricians, plumbers, surveyors, contractors, masons, design engineers, and a variety of other construction careers. (This is a companion course to Manufacturing.)

Through this curriculum the pupils are given an opportunity to learn and apply the basic knowledge and skills of the construction industry, by studying the practices which are required to build any structure, such as: dams, roads, utility networks, buildings, or tunnels. Concepts of construction technology applied in laboratory activities develop the pupils' understanding of how structures are planned, constructed, and maintained.

SUGGESTED INSTRUCTIONAL UNITS

I. MANAGING CONSTRUCTION
   - A. Beginning the Project
   - B. Designing and Engineering Construction Projects
   - C. Selecting a Builder

II. APPLYING TECHNOLOGY TO PEOPLE
   - A. Working as a Contractor
   - B. Collective Bargaining
   - C. Hiring Construction Personnel
   - D. Training and Educating for Construction
   - E. Working Conditions
   - F. Advancing in Construction
   - G. Handling Grievances
   - H. Mediating and Arbitrating
   - I. Striking

III. CONSTRUCTION PRODUCTION TECHNOLOGY
   - A. Site Preparation
   - B. Setting Foundations
   - C. Building Superstructures
   - D. Installing Utilities
   - E. Enclosing Framed Superstructures
   - F. Finishing the Project
   - G. Completing the Site
   - H. Servicing the Property

IV. CONSTRUCTION TRADES
   - A. Masonry
     1. Form Builder
     2. Concrete Mixer
     3. Concrete Finisher
     4. Brick and Block Layer
   - B. Rough Carpentry

1. Framer
2. Roofer

C. Heating and Air Conditioning
1. Climate Control Systems Designer
2. Ducting Installer
3. Insulation Installer
4. System Repairperson

D. Electricians
1. Lineworker
2. Inspector
3. Serviceperson

E. Plumbing
1. Plumber
2. Fixture Installer
3. Serviceperson

F. Finish Carpentry
1. Enclosing Exterior
2. Enclosing Interior
3. Finishing Housing
4. Cabinetry

G. Serviceperson

V. SPECIALIZED CONSTRUCTION TRADES
A. Heavy Equipment Operator
1. Excavation
2. Earth Moving
3. Paving

B. Iron Worker
1. Steel Fabricator
2. Iron Rigger
3. Ornamental Iron Worker
4. Iron Reinforcement Worker

VI. LANDSCAPING
A. Parks and Community
B. Housing

VII. COMMUNITY DEVELOPMENT
A. Residential and Dream House
B. Commercial and Industrial
C. Estimating Construction Sites

VIII. THE INDUSTRIAL ARTS STUDENT ASSOCIATION: CONSTRUCTION PROJECTS IN THE COMMUNITY

IX. SPECIFICATIONS
A. Purpose--Orientation and Exploration
B. Building Codes
C. Standard Specifications

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
WOOD TECHNOLOGY

Rationale:

This course is intended to provide students with an opportunity to study wood, wood technology, processes in fabricating and constructing wood products having design, material selection, fabrication techniques, and utility consistent with the wood producing industry. In addition, it will provide students with the major segments of the production industry producing wood products so that they may make informed future career choices.

SUGGESTED INSTRUCTIONAL UNITS

I. STANDARDIZED MATERIALS OF WOOD TECHNOLOGY
   A. Formation Anatomy and Properties of Wood
      1. The Plant Origin of Wood
      2. The Woody Plant Cell
      3. Tree Growth
      4. The Structure of Hardwoods
      5. The Structure of Softwoods
      6. Features of Wood of Value in Identification
   B. Physical Nature of Wood Nonmechanical Properties
      1. Wood-Moisture Relationship
      2. Dimensional Changes in Wood
      3. Specific Gravity and Density of Wood
      4. Thermal Properties of Wood
      5. Electrical Properties of Wood
      6. Permeability of Wood
      7. Accoustical Properties of Wood
   C. Degrade of Wood Materials
      1. Variability of Wood Within a Species
      2. Growth Related Defects in Wood
      3. Defects Due to Seasoning and Machining
   D. Wood Composites
   E. Millwork and Molding
   F. Hardware
   G. Fasteners
   H. Adhesives

*II. SAFETY AND ACCIDENT PREVENTION
   A. Introduction
   B. Machine Safety
   C. Safety Equipment

*III. PROCESSES
   A. Sawing
   B. Shaping
   C. Boring
   D. Turning
   E. Bending

*IV. DESIGN OF WOOD PRODUCTS
- A. Historical Design
  - 1. Period Furniture
  - 2. Traditional Design
- B. Design Factors
  - 1. Principle of Design
  - 2. Ornamentation
  - 3. Decorative Environment
  - 4. Effects of Color
  - 5. Upholstery
- C. Structural Design
  - 1. Selecting Construction Methods
  - 2. Joint Selection
  - 3. Making and Reading Plans
  - 4. Determining Wood Costs

*V. CABINET CONSTRUCTION
- A. Joinery
- B. Frame and Panel
- C. Leg and Rail
- D. Cabinet and Furniture Door
- E. Drawers and Guides
- F. Cabinet Interiors
- G. Leg and Post
- H. Table and Cabinet Tops

*VI. WOOD PRESERVATION (FINISHES)
- A. Materials
- B. Application

*VII. CAREER OPPORTUNITIES IN THE WOOD INDUSTRY

VIII. TOOL MAINTENANCE

*Recommended units of instruction for an 18-week course.

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
INDUSTRIAL CRAFTS

Rationale:

Industrial crafts is an important area of study in the industrial arts curriculum for several reasons. First, the industrial crafts course allows students to experience a variety of materials, tools and processes representative of their industrial and technological culture. Second, the course provides experiences which apply those industrial craft materials, tools and processes in the design and production of real-life industrial craft products, a gain through representative industrial activities. Third, and perhaps most important, the industrial crafts course permits students the opportunity to study numerous avocational elements in their modern culture. Among these avocational elements, all of which may not be available for study elsewhere in the school curriculum are: recreation, hobby and general leisure time experiences, consumer knowledge, and general technological knowledge, all which will assist students in becoming productive and responsible adults.

SUGGESTED INSTRUCTIONAL UNITS

I. CRAFT INDUSTRY
   A. The economics of American Crafts
      1. The Development of American Crafts as an Economic Force
      2. Available Markets
   B. Marketing Industrial Crafts
      1. Advertising
      2. Sales
   C. Production
      1. Individual
      2. Collective Work
      3. Mass Production
      4. Craft Cooperatives
   D. People in the Industry
      1. Creativity
      2. Individualism
      3. Age Span
      4. Education and Training Required
      5. Physical Attributes
   E. The Consumer

II. CRAFTS PLANNING AND DESIGN
   A. Design
      1. New and Original
      2. Design Integrity
      3. Discrimination
      4. Quality
      5. Elements and Principles
   B. Measurement and Layout
   C. Sketching
   D. Safety

III. MATERIAL PROCESSES
- A. Tools of the Trade
- B. Forming
- C. Fastening
- D. Assembly
- E. Finishing
- F. Quality Control
- G. Safety

IV. MATERIAL SELECTION
- A. Outcomes Desired
- B. Economy
- C. Adaptability
- D. Characteristics

V. CRAFT MATERIAL AREAS
- A. Metal
- B. Wood
- C. Plastic
- D. Leather
- E. Jewelry and Gems
- F. Fibers
- G. Ceramics
- H. Graphics
- I. Composites

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
ELECTRICAL/ELECTRONIC TECHNOLOGY

Rationale:

The purpose of a course in electrical/electronic technology is to prepare the student to consider in further detail the essential elements of a very important and flexible form of energy (electricity) and to introduce a new concept based on electricity (electronics) that unites many concepts including energy control, communication, information storage/handling, and an individual's relationship with technology and the environment. Many of the problems resulting from technology demand electrical or electronical solutions. Therefore, a course in this area is both logical and beneficial.

SUGGESTED INSTRUCTIONAL UNITS

I. Introduction to Electrical/Electronic Technology
II. Electronics Industry Definitions
III. Measurements and Instruments
IV. Symbols, Components, Ratings
V. Circuit Arrangements
VI. Electrical Relationships
VII. Alternating Current Fundamentals
VIII. Capacitive Circuits (D-C and A-C)
IX. Magnetism and Magnetic Circuits
X. Frequency Selective Circuits
XI. Motors and Generators
XII. Residential Electrical Wiring
XIII. Careers in the Electrical Industry
XIV. Introduction to Electrical Applications and Careers
XV. Discrete Semiconductor Devices and Circuits
XVI. Integrated Devices and Circuits, Analog
XVII. Introduction to Digital Electronics
XVIII. Basic Arithmetic Devices
XIX. Basic Support Devices
XX. Microprocessor Basics and Applications
XXI. Electronic Assembly Methods

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
PLASTICS TECHNOLOGY

Rationale:

Plastics should be taught in the school in order to familiarize the students with the plastics industry, its materials, and processes. The industry needs people for management, production control, designing, and production who have a good knowledge of the field. In addition, the industry needs a consuming public that is literate about plastics.

SUGGESTED INSTRUCTIONAL UNITS

I. INTRODUCTION AND ORIENTATION
   A. Overview
   B. Safety
   C. Career Opportunities

II. MATERIALS AND PROCESSES
   A. Identification of Plastics
   B. Industrial Processes
   C. Thermoplastic Group
      1. Thermoforming
      2. Plastisol Casting
      3. Foam Molding, Expandable
      4. Coating
      5. Molding
   D. Thermoset Group
      1. Reinforcing Processes
      2. Molding
      3. Laminating and Reinforcing
      4. Simple Casting
      5. Foaming, Chemical, Mechanical, and Other Means

III. FABRICATING AND FINISHING
   A. Cutting and Finishing
   B. Joining and Fastening

IV. MATERIALS TESTING
   A. Chemical
   B. Physical
   C. Thermal
   D. Electrical

V. MOLD AND MOLD CONSTRUCTION
   A. Types
      1. Positive (Male)
      2. Negative (Female)
      3. Matched
      4. Die
   B. Materials

1. Wood
2. Plaster
3. Plastics
4. Metal
5. Clay
6. Wax
7. Rubber

VI. CAREER OPPORTUNITIES

VII. APPLICATION

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
METAL TECHNOLOGY

Rationale:

Manufacturing is the mechanism within the larger production system in our culture which is responsible for processing raw materials into desired goods. Metal materials and manufacturing, hereafter referred to as metal technology, constitutes one of the single most powerful sectors in our culture--its materials, processing, management, careers, opportunities, and problems. Thus, it is important that metal technology be included in studies about production, and even more important that metal technology be studied by teachers and students in industrial arts.

SUGGESTED INSTRUCTIONAL UNITS

I. INTRODUCTION TO METAL TECHNOLOGY

II. METAL MATERIALS
- A. The Nature of Metal Materials
  - 1. Physical Characteristics
  - 2. Bonding Properties
  - 3. Behavioral Properties
- B. Material Requirements
  - 1. Manufacturing
  - 2. Service
  - 3. Selection
- C. Material Classification
  - 1. Ferrous
  - 2. Nonferrous
  - 3. Alloys
- D. Standardized Metal Materials

III. PROCESSES
- A. Metal Cutting and Forming
  - 1. Principles of Metal Separation
  - 2. Metal Separation by Shearing and Drilling
  - 3. Practices of Metal Forming
- B. Conditioning, Bonding and Fastening Processes
  - 1. Bonding Processes by Joining
  - 2. Bonding by Heat and Pressure
  - 3. Bonding with Chemical Heat
  - 4. Separating Bonds by Heat
  - 5. Adhesive Bonding
  - 6. Conditioning and Restoration Processes

IV. APPLICATION: MANUFACTURING FINISHED PRODUCTS
- A. Product Planning
  - 1. Measuring and Laying Out Metals
  - 2. Reading BLueprints
  - 3. Metal Product Design
- B. Principles and Practices of Assembly

1. Assembly Principles
2. Assembly Operations

C. Metal Finishing Processes
1. Finishing Principles
2. Finishing Materials and Applications

V. CAREER OPPORTUNITIES IN METAL TECHNOLOGY
A. Career Classifications
1. Semi-skilled
2. Skilled
3. Technical
4. Professional

VI. SAFETY

SENIOR HIGH SCHOOL INDUSTRIAL EDUCATION (11-12)
POWER TECHNOLOGY

Rationale:

The purpose of studies in the energy/power area is to develop a realization, through activity-oriented instruction, that energy availability, conversion, efficient usage, conservation, and futuristic concerns are essential to life. Studies about energy/power involve classroom and hands-on activities. These studies should prepare the student to consider the socioeconomic and environmental impacts and the occupational aspects of the energy/power field.

A course in power technology is also important because students should become aware of possible problems, areas needing research, development, career choices and opportunities relating to modern technology.

SUGGESTED INSTRUCTIONAL UNITS

I. Introducing Power Technology
II. Basic Power Technology Concepts
III. Machines
IV. Conversion of Power: Heat Engines
V. Electrical Conversion of Power
VI. Mechanical Transmission of Power
VII. Fluid Power
VIII. Atomic Power
IX. Research and Development
X. Careers in Power Technology

PROGRAMS: 13.17

SCHEMATIC INTERRELATIONSHIP AND SEQUENCE OF PROGRAMS

AWARENESS	ORIENTATION	EXPLORATION	PREPARATION	SPECIALIZATION
Insights	Conceptualization		Pre-technical	Post Secondary
ACTIVITIES INTEGRATED WITHIN CURRICULUM	INDUSTRIAL LITERACY AND TECHNOLOGICAL LITERACY	COMMUNICATION CONSTRUCTION MANUFACTURING ENERGY/POWER TRANSPORTATION	DESIGN-DRAFTING GRAPHIC ARTS CONSTRUCTION WOOD TECHNOLOGY INDUSTRIAL CRAFTS ELECTRICITY/ ELECTRONICS PLASTICS TECHNOLOGY METALS TECHNOLOGY POWER TECHNOLOGY	ENGINEERING PROGRAMS INDUSTRIAL TECHNOLOGY PROGRAMS TECHNICAL INSTITUTES VOCATIONAL-TECHNICAL SCHOOLS APPRENTICESHIP ON-THE-JOB TRAINING TEACHER EDUCATION
Activities	Laboratory Clusters		Unit or General Laboratory	Specialized Unit Laboratory
K - 6	7 - 8	9 - 10	11 - 12	13 - 17

TEACHER EDUCATION (13-17)
INDUSTRIAL ARTS EDUCATION

Industrial arts instructors are required to meet professional certification criteria in order to become endorsed in the state of South Dakota. Endorsement indicates that the instructor has successfully completed a specified program of studies which will allow the person to operate a safe and educationally beneficial program.

Industrial arts courses should be exploratory, covering a minimum of six cluster areas. The desired outcomes should be designed to give students a broad educational background. Emphasis and attention should be given to helping students discover and develop their aptitudes, abilities and interests which may, in turn, become the background for later vocational training of professional education careers.

Colleges providing programs for the preparation of teachers of industrial arts should design these programs with the above objectives in mind. The program should include a minimum of 36 semester hours and should be designed to develop competencies in the following areas:

1. Industrial and Technological Literacy
2. Communications
3. Construction
4. Manufacturing
5. Energy/Power
6. Transportation

APPENDIX

--APPENDIX A--

ALTERNATIVE METHODS AND APPROACHES OF INSTRUCTION

Success in the classroom depends on many factors. Foremost among these is hard work on the part of the teacher. Educational programs must be adaptable. They must be flexible enough to remain workable in all locales, in many types of facilities, and with students possessing differing values and interests. A successful program must be capable of application in all situations and at all levels. The program recommended in the guide is believed to be such a program.

Curriculum content is not the only important element in the teaching-learning environment. Because of the differences in pupil learning styles and teacher proficiencies, varied instructional methods must continually be evaluated and implemented. Traditionally, many instructional methods have been used in industrial arts and technology laboratories. Methods such as lecturing, demonstrating, designing, problem-solving, and constructing individual projects have been recognized as effective instructional approaches for presenting content. Emerging instructional methodologies provide increased potential for presenting technical, industrial and career concepts. Some instructional patterns being used in innovative industrial arts programs today include:

ROLE-PLAYING

The role-playing method affords students the opportunity to identify themselves with typical life activities as they exist in simulated industrial occupations or professions. Through role-playing, students can experience some of the reality of work responsibilities. It is especially well-suited for use with enterprise laboratory activities, mass-production activities, research and experimentation, and group project experiences.

THE GROUP PROJECT

The group project method involves the designing, planning and development of a product by a group of students. It differs from the mass-production method in that only one finished product selected has numerous elements that permit the effective use of committees or other sub-groups. The method has been used successfully at the junior high level for studying high volume production industries such as paper and paper products, oil, iron, glass, and rubber. At the senior high level, the group project might take the form of designing and constructing machine or vehicle prototype.

CONCEPTUAL LEARNING

Current educational theory emphasizes the need to develop fundamental principles and ideas which have functional value in a wide variety of applications. This learning generally is referred to as conceptual learning. For example, the concept of molding enables the student to relate general knowledge and skills to many specific types of industrial processes in forging, foundry, and casting. A study of general or fundamental principles insures that memory loss will not mean total loss, and will permit reconstruction of details, when necessary. Concepts have greater application to new situations than specific facts.

ENTERPRISE

The industrial enterprise approach represents a simulated production experience where students assume career roles and solve problems in a manner similar to their counterparts in industry. The enterprise method often involves such activities as research and development, financing, mass-production, distribution, and marketing. At elementary and junior high levels, the emphasis might be directed toward production of items of a simplified nature. Limited time would be allotted for performance of the production activity. At the senior high level, production solutions are more refined and greater emphasis is placed on tooling for production.

COOPERATIVE WORK AND STUDY

Many students enrolled in industrial arts programs can profit from on-the-job experiences which are designed to supplement in-school learning experiences. Such experiences assist students in further development of skills and positive attitudes toward work and school, aid them in assessing career goals, and enhance their potential for successful employment in the future. Other significant techniques include industrial observation schemes and community projects. All out-of-school industrial experiences require supervision and evaluation by qualified school personnel to ensure that the experience and environment are adequately serving the student's educational goals.

SEMINAR

The seminar method emphasizes student interaction and contribution. It is used to identify individual problems and to provide for group assistance on finding solutions to these problems. The seminar provides a continuing opportunity for student/peer evaulations as well as presentation of individual student progress. With the seminar method, the teacher assumes the role of a facilitator, observer, evaluator, and advisor. In the seminar, students become involved in challenging, questioning, assisting, and discussing. The method has been used successfully with the enterprise, group, research and experimentation, and other more traditional instructional methodologies.

INDIVIDUALIZED INSTRUCTION

Individualized instruction provides for the varying abilities and interest of students. It involves development of instructional units in a manner which enables the student to independently: (1) pre-assess his/her performance and knowledge of the unit objectives, (2) progress through

specified learning activities at his/her own rate, and (3) assess his/her terminal performance and achievement of unit objectives. A variety of hardware and software systems have been developed to facilitate management of the instructional approach. These include auto-tutorial systems, tape-slide, tape-filmstrip, programmed references, student contracts, learning activity packages, educational games, and computer assisted instruction.

USING COMMUNITY RESOURCES

Methods must be selected that capitalize on the unique needs of students in specific locales. The teacher of industrial arts must be alert to the resources of his/her community and the opportunities for integrating these resources with the instructional program. Resource speakers, industrial visitations, films, slides, tapes, learning packages, and bibliographical resource materials must all be evaluated on the basis of their merit to the instructional program.

--APPENDIX B--

The following ten standards may be used to evaluate or further develop the industrial arts education program. A complete and detached standards list may be found in the "Standards for Industrial Arts Programs," available from the American Industrial Arts Association, 1914 Association Drive, Reston, Virginia 22091, (703)860-2100.

PHILOSOPHY

A current, comprehensive and written philosophical statement is available and influences thought and action for industrial arts.

1.1 Development
A philosphical statement for including industrial arts as an integral part of the total school curriculum is developed.

1.2 Utilization
The philosophical statement is the basis for program direction.

1.3 Review and Revise
The philosophical statement is reviewed periodically and revised when necessary.

INSTRUCTIONAL PROGRAM

The instructional program reflects the stated industrial arts philosophy through experiences designed to meet the needs of all students.

2.1 Goals
Program goals are established from the stated philosophy to provide direction for program development, implementation, and evaluation.

2.2 Objectives
Objectives which reflect program goals are utilized for each course.

2.3 Content
Course content reflects the intent of the course objectives.

2.4 Scheduling
Industrial arts courses are of sufficient duration to achieve stated program objectives.

STUDENT POPULATIONS SERVED

3.1 Individual Differences
All students, regardless of their abilites and needs, are served by the industrial arts program.

3.2 Sex Equity
Industrial arts is provided equitably for females as well as males.

INSTRUCTIONAL STAFF

The instructional staff is both professionally and technically competent to provide competency requirements.

4.1 Legal/Regulatory Qualifications
The instructional staff meets established state and local degree, certification, and competency requirements.

4.2 Professional Responsibilities
The industrial arts teacher fulfills the roles and responsibilities of a professional educator.

4.3 Personal Qualities
The industrial arts teacher exhibits personal qualities that contribute to the fulfillment of professional responsibilities.

ADMINISTRATION AND SUPERVISION

Administration and supervision are provided at all levels to ensure a well managed and comprehensive industrial arts program.

5.1 Staffing
An adequate number of certified and qualified administrators, supervisors, and faculty is provided to ensure attainment of program goals and objectives.

5.2 Planning and Organizing
A system is provided which ensures program direction, short and long range planning, organization, and administration for program operation and improvement.

5.3 Budgeting
A budgeting system is utilized to ensure the identification and procurement of all resources essential for the accomplishment of program goals and course objectives, consistent with student enrollment and unique student needs.

5.4 Directing and Monitoring
Appropriate policy statements, written directives, and supervisory visits are utilized to ensure full program implementation.

5.5 Data Collecting and Reporting
An information system is utilized to collect, analyze, transmit, and maintain data on programs, teachers, and students.

5.6 Communicating
Communication is maintained among faculty, administrative personnel, students, and the community.

SUPPORT SYSTEMS

Support systems provide human, physical, and financial resources instrumental for attaining program goals and objectives.

6.1 Human Resources
Personnel services are provided and utilized to support and supplement the industrial arts program.

6.2 Physical Resources
Physical resources such as the facility, equipment, and instructional materials are provided to assist in achieving the program goals and course objectives.

6.3 Financial Resources
Sufficient funds are budgeted and expended to operate and maintain the industrial arts program.

INSTRUCTIONAL STRATEGIES

Appropriate instructional strategies are designed and utilized to meet program goals, course objectives, and student needs.

7.1 Planning
Written instructional plans which meet individual needs are developed and utilized to achieve stated course objectives.

7.2 Implementing
Instructional and leadership development methods are utilized to accomplish course objectives and meet the unique needs of individual students.

7.3 Reviewing and Revising
Instructional strategies are evaluated periodically and revised when necessary.

PUBLIC RELATIONS

8.1 Target Populations
The educational community, the lay public, business, industry, and government are informed of and given the opportunity to participate in industrial arts programs and activities.

8.2 Media
Various media are utilized to communicate the goals, objectives, and accomplishments of the industrial arts program.

SAFETY AND HEALTH

A written comprehensive safety and health program is implemented to ensure safe working conditions and practices.

9.1 Program
Learning experiences and activities are designed for the development of knowledge, skills, and attitudes concerning the safe use of tools, machines, materials, and processes.

9.2 Physical Environment
The physical facilities and equipment are designed, constructed, and maintained to ensure a safe and healthful learning environment.

9.3 Records
Records are on file to document the existence of an effective safety and health program.

EVALUATION PROCESS

A systematic, continuous evaluation program exists and utilizes standards to assess all elements of industrial arts programs.

10.1 Establishing a Data Collection and Analysis System
Appropriate procedures are established and utilized to obtain valid and reliable information for program assessment.

10.2 Collecting and Analyzing Data
Data on selected aspects of the industrial arts program are collected on a prescribed schedule.

10.3 Reporting
An assessment report containing data, notations of discrepancies, and recommendations is made annually.

10.4 Decision Making
Decisions for program improvement are based upon the assessment report.

--APPENDIX C--

AMERICAN INDUSTRIAL ARTS STUDENT ASSOCIATION (AIASA)

Description:

The South Dakota Association of the American Industrial Arts Student Association (AIASA) helps students learn to live in a technical world. The association enables students to do the following:

1. Develop democratic awareness and practices;
2. Observe student performance, craftsmanship and safety; and
3. Become involved with the community's industrial and technical resources.

AIASA activities at the elementary school level are extracurricular. The middle or junior high and high school level programs include AIASA in the regular curriculum.

Goal--Leadership/Citizenship Development:

The goal of the American Industrial Arts Student Association is to help students develop leadership qualities as well as high standards of craftsmanship, scholarship and safety.

Standards:

To accomplish the goal of the organization, all AIASA chapters should contain the following elements:

1. Integrated Activities

   Chapter activities will be an integral part of the instructional program and will be supervised by industrial arts personnel.

2. Community Resources

   Community resources will be included in industrial arts activities.

3. Participatory Democracy

   Students in the chapter will participate in parliamentary procedures and democratic decision-making.

4. Recognition of Achievement

   Students will be recognized for performance, craftsmanship and safety.

RESOURCES

SELECTED REFERENCES AND RESOURCES

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